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Fetal breech presentation: impact on perinatal posture and locomotion

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General introduction



In the Netherlands, about 190.000 live births occur every year [1]. Of these children the vast majority is born in cephalic presentation, which means with the head first. Breech presentation is defined as the presentation in which the fetal head is positioned in the fundus (the upper part of the uterus) and the fetal buttocks are facing toward the maternal cervix. Three different types of breech presentation can be distinguished. Frank breech (50 to 70 percent of cases at term age) refers to a fetus with both hips flexed and both knees extended so its feet are near its head. Complete breech (5 to 10 percent) refers to a fetus with both hips and both knees flexed. Incomplete breech (10 to 40 percent) refers to a fetus with one or both hips not flexed.

The frequency of breech presentation in singleton pregnancies decreases with advancing gestational age, from about 25 % at 28 weeks gestational age to around 3 % at term [10,11]. Adopting the cephalic presentation is thought to be the result of an active process whereby a mobile, normally proportioned fetus in an average volume of amniotic fluid finds the position of best fit in the available intrauterine space. Breech presentation is associated with a variety of conditions, including fetal abnormalities (hydrocephaly, anencephaly), maternal conditions (uterine anomalies, pelvic tumours or anomalies) and obstetric factors (including abnormal amniotic fluid volume, abnormal placentation, preterm labour and multifetal gestation). Nevertheless, for approximately 85 % of all term breech presentations no aetiological explanation can be found. This has led to several hypotheses regarding the origins of term breech presentation in otherwise uncomplicated pregnancies, ranging from a chance occurrence to implications about (neuromotor) factors intrinsic to the breech fetuses being responsible for both the breech presentation and for some subsequent neurological abnormalities [2,13,14].

Subtle prenatal behavioural differences have been reported by Kean et. al. [14] with healthy term breech fetuses showing significantly more behavioural state transitions than their cephalic controls while on the other hand no differences were found between both groups in movement rates, number of accelerations and amount of time showing low and high fetal heart rate variation. Takashima et. al., in a study on fetal eye movements, demonstrated a different in-utero developmental course in breech fetuses when compared to cephalic fetuses when considering the proportion of eye-movements in different directions [21].

Recently, Van der Meulen et. al. [22] reported their findings in healthy breech fetuses of fewer body movements in response to vibroacoustic stimuli and more body movements to an airborne sound. These findings may reflect differences in sensory experiences between breech and cephalic fetuses with possible implications for the development of neuronal networks in the perinatal period. Spontaneous behaviour was not found to be different between the breech and cephalic fetuses, in accordance with other researchers. Sival et. al. reported on qualitatively normal fetal general movements in otherwise uncomplicated breech pregnancies [20].

Breech infants show significantly lower birth weights than cephalic infants, even after adjusting for gestational age at birth [14,16]. It has been proposed that possible utero-placental factors causing a moderate intra-uterine growth restriction might be involved in the pathogenesis of breech presentation.

The reported subtle prenatal differences have not been shown to lead to permanent postnatal neurological impairments in healthy breech-borns. Sival et. al. [20] could not find differences between breech and cephalic infants in the age at which developmental milestones were reached. Nor did they find neurological deficits at the age of 18 months despite early postnatal differences between breech- and cephalic-born infants regarding leg reflexes. Bartlett et. al. [3] could not find differences between breech infants and cephalic controls in thirteen primitive reflexes studied during the first five months after birth. The same group did report on minor transient differences in leg motor development in breech infants compared with cephalic-presenting infants [4]. But, as a group, breech-presenting infants did not have a persistent, inherently different pattern of motor development than cephalic-presenting infants.

Breech infants experience a higher risk of complications during delivery than cephalic infants. These include umbilical cord prolapse (protrusion of the umbilical cord in advance of the fetal presenting part because of inadequate filling of the maternal pelvis by the presenting part of the breech fetus), asphyxia and direct mechanical trauma (mostly because of possible problems with delivering the fetal head after delivery of the body because the skull has not had sufficient time to mould when passing through the pelvis). These complications lead to a higher risk of neonatal morbidity and mortality in

breech babies. Up until the 1950s, the preferred mode of delivery of breech infants in the Netherlands was via the vaginal route. But since then a growing number of caesarean sections is being performed for this indication. Especially since the publication, in 2000, of a large multicentre randomised trial concluding that planned caesarean section is preferable over planned vaginal birth for the term fetus in breech presentation [8]. Recent publications on the same study population, however, fail to find a difference in outcome between fetuses in both delivery groups after a 2-year follow-up [23]. Earlier reports on long-term follow-up by means of neurological and general examination of breech-born infants also suggest that late morbidity is probably more influenced by general obstetrical and neonatal factors than the mode of delivery itself [7].

Changes in intrauterine environment have been found to influence fetal and later postnatal behaviour. For example in pregnancies complicated by oligohydramnios transient effects have been found on the quality of fetal and neonatal movements until 5 weeks after birth [19]. Even in the rather physiological circumstance of the uncomplicated breech presentation, movement restriction of the fetal hips - which in case of breech presentation are surrounded by the maternal pelvic bone - is thought to play a major role in abnormal postnatal development of leg function.

Breech presentation is known to be a major risk factor for the development of hip dysplasia [5,12,17]. The risk is higher in infants with frank breech than with complete breech presentation [5,15]. The increased risk of hip dysplasia seems to be present regardless of the method of delivery, however, some authors report that prelabor Caesarean delivery may decrease the risk [15]. Transient restrictions in neonatal hip joint movements after fetal breech presentation have already been reported on since the fifties [9] and are still being investigated.

For complete understanding of the postnatal effects of breech presentation it is important to know more about the prenatal development of these infants. Reports on prenatal postural development of breech fetuses in uncomplicated pregnancies are, however, mostly based on single and short-lasting observations.

Aims and outline of the thesis

The aim of this thesis was to observe the influence of prolonged fetal breech presentation (from at least 33 weeks gestational age) in uncomplicated pregnancies on the development of head-, arm- and leg posture and movement. Observation of posture and movements in infants has long been used as an item in determining the maturity and the integrity of the central nervous system, especially in preterms [6,18]. Nowadays, with the application of ultrasound, we are able to study fetal posture and movements. By doing this, information can be obtained about fetal neuromotor development by observation of the posture and movements of the fetus in its own intrauterine environment, instead of making inferences about fetal behaviour from neonatal observations. Also, studies on the impact of the transition from prenatal to postnatal life are now possible.

We used a study design in which only one environmental factor was different between two groups of healthy fetuses, namely their position inside the womb being either breech or cephalic. Breech fetuses experience a different intrauterine environment than cephalic ones. First, because of the pear-shaped uterus, the lower part of the pregnant uterus probably provides less movement freedom for the fetus than the upper part. Also, especially towards the end of pregnancy, the fetal parts in the lower segment of the uterus are surrounded by the bony maternal pelvis. This could, at least theoretically, provide even more movement restriction, when compared to the upper part of the uterus. Third, a different distribution of amniotic fluid creating more space for movements in the upper part of the uterus.

Our study design is unique because of the longitudinal approach so that changes in time resulting from prolonged duration of the intra-uterine fetal presentation could be observed. Also, the fact that we did postnatal follow-up -again longitudinally- of both groups contributes to the special position of this project among others concerning this subject. This study design gave us the opportunity to study transitions in time, after a certain period of exposure to a given intra-uterine environment. As focus has up to now primarily been placed on influence of the breech presentation on leg movements, we found it interesting to see if

changes in intra-uterine environment might also lead to changes in other aspects of fetal postural development.

And not only prenatally, but we could also observe the change from prenatal to postnatal environment. Prenatally the fetus experiences a situation with a relatively large restriction of movement and a relatively small impact of gravity. In the postnatal life on the one hand spatial restraints are diminished, but on the other hand gravity has a pronounced effect and in fact offers a major restriction for early postnatal motility. Observations at the age of 2.5 years will give insight in differences between both groups in a functional task. The intensity of the number of observations performed on each fetus/infant was such that the size of the study groups was kept relatively small.

In **chapter 2** we describe the development of head orientation preference in healthy breech fetuses in comparison to healthy cephalic fetuses. We address different questions: How does head-position preference develop in breech fetuses? Is the development of head-position preference different between breech and cephalic fetuses? How can we relate development of lateralisation to the left-otolith dominance theory? What influence can we find of fetal head shape on the development of prenatal head lateralisation? In **chapter 3** we focus on the influence of breech presentation on the development of fetal arm posture. We studied the developmental trend in elbow, wrist, and finger posture for breech fetuses in the third trimester of pregnancy. We answer the question if there is a difference in development of arm posture between healthy breech and cephalic fetuses in the third trimester of pregnancy. **Chapter 4** shows the results of our examination of the intra-uterine leg posture development in breech and cephalic fetuses during the last trimester of pregnancy. We observed the development over time of leg posture in both groups and examined possible differences between the groups in this aspect of fetal posture. In **chapter 5** we report on the short-term postnatal follow-up of leg posture during general movements from 2 to 18 weeks after birth in the studied groups. Changes in leg posture during the first weeks of postnatal life were studied, as well as differences between the groups. We also looked at the influence on leg posture of changing from supine to vertical position in both groups. In the supine condition the impact of gravity is more similar to the prenatal situation with less influence of gravity as opposed to the vertical condition with more impact of

gravitational forces. And finally we looked at continuity between pre- and postnatal findings within the groups. **Chapter 6** addresses the long-term effects on leg movements. We investigated the effect of prenatal breech presentation on locomotion at 2.5 years by conducting two complementary studies. Firstly, a gait analysis was carried out. Secondly, in a functional task the children were challenged to cross a gap until their maximum attainable crossing distance was reached. Finally, in **chapter 7** we shortly report on our findings in three fetuses who spontaneously verted to cephalic presentation during the study period. These observations might give insight in the way in which fetal head-, arm- and leg posture of fetuses who had previously been in breech presentation adapt to this prenatal change.

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